WHAT IS CLAIMED IS:

1.   For use in a degree of outlier calculation device
for sequentially calculating a degree of outlier of each
data with a data sequence of real vector values as input,
a probability density estimation device for, while
5   sequentially reading said data sequence, estimating a
probability distribution of generation of the data in
question by using a finite mixture distribution of
normal distributions, comprising:
        probability calculation means for calculating,
10   based on a value of input data and values of a mean
parameter and a variance parameter of each of a finite
number of normal distribution densities, a probability
of generation of the input data in question from each
normal distribution; and
15   parameter rewriting means for updating and
rewriting the stored parameter values while forgetting
past data, according to newly read data based on a
probability obtained by the probability calculation
means, values of a mean parameter and a variance
20   parameter of each normal distribution and a weighting
parameter of each normal distribution.

2.   The probability density estimation device as set
forth in claim 1, further comprising
        parameter storage means for storing values of a

mean parameter and a variance parameter of each of a

5   finite number of normal distribution densities and a

weighting parameter of each normal distribution, wherein

said parameter rewriting means updates and

rewrites data of said parameter storage means.

3.   A degree of outlier calculation device for

sequentially calculating a degree of outlier of each

data with a data sequence of real vector values as input,

comprising:

5   a probability density estimation device for,

while sequentially reading said data sequence,

estimating a probability distribution of generation of

the data in question by using a finite mixture of normal

distributions including

10   (a) parameter storage means for storing values of

a mean parameter and a variance parameter of each of a

finite number of normal distribution densities and a

weighting parameter of each normal distribution,

(b) probability calculation means for calculating,

15   based on a value of input data and values of a mean

parameter and a variance parameter of each of a finite

number of normal distribution densities, a probability

of generation of the input data in question from each

normal distribution, and

20   (c) parameter rewriting means for updating and

rewriting the stored parameter values while forgetting

past data, according to newly read data based on a probability obtained by the probability calculation means, values of a mean parameter and a variance parameter of each normal distribution and a weighting parameter of each normal distribution, and

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degree of outlier calculation means for calculating and outputting a degree of outlier of said data by using a parameter of the normal mixture updated by said probability density estimation device and based on a probability distribution estimated from values of the parameters before and after the updating and the input data.

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4.   A probability density estimation device for use in a degree of outlier calculation device to, while sequentially reading a data sequence, estimate a probability distribution of generation of the data in question by using a finite number of normal kernel distributions, comprising:

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parameter storage means for storing a value of a parameter indicative of a position of each kernel, and

parameter rewriting means for reading a value of a parameter from the storage means and updating the stored parameter values while forgetting past data, according to newly read data to rewrite the contents of the parameter storage means.

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5.   A degree of outlier calculation device for
sequentially calculating a degree of outlier of each
data with a data sequence of real vector values as input,
comprising:

5   a probability density estimation device for,
while sequentially reading said data sequence,
estimating a probability distribution of generation of
the data in question by using a finite number of normal
kernel distributions including

10   (a) parameter storage means for storing a value
of a parameter indicative of a position of each kernel,
and

            (b) parameter rewriting means for reading a value
of a parameter from the storage means and updating the
15   stored parameter values while forgetting past data,
according to newly read data to rewrite the contents of
the parameter storage means, and

            degree of outlier calculation means for
calculating and outputting a degree of outlier of said
20   data by using said parameter updated by said probability
density estimation device and based on a probability
distribution estimated from values of the parameters
before and after the updating and the input data.

6.   For use in a degree of outlier calculation device
for sequentially calculating a degree of outlier of each
data with discrete value data as input, a histogram

calculation device for calculating a parameter of a

5   histogram with respect to said discrete value data

sequentially input, comprising:

storage means for storing a parameter value of

said histogram, and

parameter updating means for reading said

10   parameter value from the storage means and updating past

parameter values while forgetting past data based on

input data to rewrite the value of said storage means,

thereby outputting some of parameter values of said

storage means.

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7.   A degree of outlier calculation device for

sequentially calculating a degree of outlier of each

data with discrete value data as input, comprising:

a histogram calculation device for calculating a

5   parameter of a histogram with respect to said discrete

value data sequentially input including

storage means for storing a parameter value of

said histogram, and

parameter updating means for reading said

10   parameter value from the storage means and updating past

parameter values while forgetting past data based on

input data to rewrite the value of said storage means,

thereby outputting some of parameter values of said

storage means, and

15   score calculation means for calculating, based on

the output of the histogram calculation device and said

input data, a score of the input data in question with

respect to said histogram, thereby outputting the output

of the score calculation means as a degree of outlier of

20   said input data.

8.   A degree of outlier calculation device for

calculating a degree of outlier with respect to

sequentially input data which is described both in a

discrete value and a continuous value , comprising:

5   a histogram calculation device for estimating a

histogram with respect to a discrete value data part,

probability density estimation devices provided

as many as the number of cells of said histogram for

estimating a probability density with respect to a

10   continuous value data part,

cell determination means for determining to which

cell of said histogram said discrete value data part

belongs to send the continuous data part to the

corresponding one of said probability density estimation

15   devices, and

score calculation means for calculating a score

of said input data based on a probability distribution

estimated from output values of said histogram

calculation device and said probability density

20   estimation device and said input data, thereby

outputting the output of the score calculation

means as a degree of outlier of said input data,

said histogram calculation device including

storage means for storing a parameter value of

said histogram, and

parameter updating means for reading said

parameter value from the storage means and updating past

parameter values while forgetting past data based on

input data to rewrite the value of said storage means,

thereby outputting some of parameter values of said

storage means, and

said probability density estimation device

including

parameter storage means for storing values of a

mean parameter and a variance parameter of each of a

finite number of normal distribution densities and a

weighting parameter of each normal distribution,

probability calculation means for calculating,

based on a value of input data, and values of a mean

parameter and a variance parameter of each of a finite

number of normal distribution densities, a probability

of generation of the input data in question from each

normal distribution, and

parameter rewriting means for updating and

rewriting the stored parameter values while forgetting

past data, according to newly read data based on a

probability obtained by the probability calculation

means, values of a mean parameter and a variance

parameter of each normal distribution and a weighting

50   parameter of each normal distribution.

9.   A degree of outlier calculation device for

calculating a degree of outlier with respect to

sequentially input data which is described both in a

discrete value and a continuous value , comprising:

5   a histogram calculation device for estimating a

histogram with respect to said discrete value data part,

           probability density estimation devices provided

as many as the number of cells of said histogram for

estimating a probability density with respect to a

10   continuous value data part,

           cell determination means for determining to which

cell of the histogram said discrete value data part

belongs to send the continuous data part to the

corresponding one of said probability density estimation

15   devices, and

           score calculation means for calculating a score

of said input data based on a probability distribution

estimated from output values of said histogram

calculation device and said probability density

20   estimation device and said input data, thereby

           outputting the output of the score calculation

means as a degree of outlier of said input data,

           said histogram calculation device including

           storage means for storing a parameter value of

25   said histogram, and

              parameter updating means for reading said
parameter value from the storage means and updating past
parameter values while forgetting past data based on
input data to rewrite the value of said storage means,
30   thereby outputting some of parameter values of said
storage means, and

              said probability density estimation device
including

              parameter storage means for storing a value of a
35   parameter indicative of a position of each kernel, and

              parameter rewriting means for reading a value of
a parameter from the storage means and updating the
stored parameter values while forgetting past data,
according to newly read data to rewrite the contents of
40   the parameter storage means.

10.   For use in a degree of outlier calculation device
for sequentially calculating a degree of outlier of each
data with a data sequence of real vector values as input,
a probability density estimation method of, while
5   sequentially reading said data sequence, estimating a
probability distribution of generation of the data in
question by using a finite mixture of normal
distributions, comprising the steps of:

              based on values of a mean parameter and a
10   variance parameter of each of a finite number of normal

distribution densities read from parameter storage means for storing a value of input data, values of a mean parameter and a variance parameter of each of a finite number of normal distribution densities, and a weighting parameter of each normal distribution, calculating a probability of generation of the input data in question from each normal distribution, and

updating the stored parameter values while forgetting past data, according to newly read data based on a probability obtained by the probability calculation means, values of a mean parameter and a variance parameter of each normal distribution and a weighting parameter of each normal distribution to rewrite data of said parameter storage means.

11.   A degree of outlier calculation method of sequentially calculating a degree of outlier of each data, with a data sequence of real vector values as input, wherein

probability density estimation for, while sequentially reading said data sequence, estimating a probability distribution of generation of the data in question by using a finite mixture of normal distributions, comprises the steps of:

based on values of a mean parameter and a variance parameter of each of a finite number of normal distribution densities read from parameter storage means

for storing a value of input data, values of a mean
parameter and a variance parameter of each of a finite
number of normal distribution densities, and a weighting
parameter of each normal distribution, calculating a
probability of generation of the input data in question
from each normal distribution, and

updating the stored parameter values while
forgetting past data, according to newly read data based
on a probability obtained by the probability calculation
means, values of a mean parameter and a variance
parameter of each normal distribution and a weighting
parameter of each normal distribution to rewrite data of
said parameter storage means, and which further
comprises the step of:

calculating and outputting a degree of outlier of
said data by using a parameter of the finite mixture
distribution updated by said probability density
estimation and based on a probability distribution
estimated from values of the parameters before and after
the updating and the input data.

12.   A probability density estimation method for use
in calculation of a degree of outlier to, while
sequentially reading a data sequence, estimate a
probability distribution of generation of the data in
question by using a finite number of normal kernel
distributions, comprising the steps of:

storing a value of a parameter indicative of a position of each kernel in parameter storage means, and

reading a value of a parameter from the storage

10   means and updating the stored parameter values while forgetting past data, according to newly read data to rewrite the contents of the parameter storage means.

13.   A degree of outlier calculation method of sequentially calculating a degree of outlier of each data, with a data sequence of real vector values as input, wherein

5   probability density estimation for, while sequentially reading said data sequence, estimating a probability distribution of generation of the data in question by using a finite number of normal kernel distributions comprises the steps of:

10   storing a value of a parameter indicative of a position of each kernel in parameter storage means,

reading a value of a parameter from the storage means and updating the stored parameter values while forgetting past data, according to newly read data to

15   rewrite the contents of the parameter storage means, and which further comprises:

degree of outlier calculation means for calculating and outputting a degree of outlier of said data by using said parameter updated by said probability

20   density estimation and based on a probability

distribution estimated from values of the parameters
before and after the updating and the input data.

14.   For use in calculation of a degree of outlier for
sequentially calculating a degree of outlier of each
data with discrete value data as input, a histogram
calculation method of calculating a parameter of a

5   histogram with respect to said discrete value data
sequentially input, comprising the steps of:
        reading said parameter value from storage means
for storing a parameter value of said histogram and
updating past parameter values while forgetting past

10   data based on input data to rewrite the value of said
storage means, and
        outputting some of parameter values of said
storage means.

15.   A degree of outlier calculation device for
sequentially calculating a degree of outlier of each
data with discrete value data as input, comprising:
        a histogram calculation device for calculating a

5   parameter of a histogram with respect to said discrete
value data sequentially input including
        storage means for storing a parameter value of
said histogram, and
        parameter updating means for reading said

10   parameter value from the storage means and updating past

parameter values while forgetting past data based on input data to rewrite the value of said storage means, thereby outputting some of parameter values of said storage means, and

15   score calculation means for calculating, based on the output of the histogram calculation device and said input data, a score of the input data in question with respect to said histogram, thereby outputting the score calculation result as a degree of outlier of said input

20   data.

16.   A degree of outlier calculation method of calculating a degree of outlier with respect to sequentially input data which is described both in a discrete value and a continuous value , wherein

5   histogram calculation which estimates a histogram with respect to a discrete value data part comprises the steps of:

        reading said parameter value from storage means for storing a parameter value of said histogram and

10   updating past parameter values while forgetting past data based on input data to rewrite the value of said storage means, and

        outputting some of parameter values of said storage means, and wherein

15   in probability density estimation devices provided as many as the number of cells of said

histogram for estimating a probability density with respect to a continuous value data part, said method comprises the steps of:

20   based on values of a mean parameter and a variance parameter of each of a finite number of normal distribution densities read from parameter storage means for storing a value of input data, values of a mean parameter and variance parameter of each of a finite

25   number of normal distribution densities and a weighting parameter of each normal distribution, calculating a probability of generation of the input data in question from each normal distribution, and

       based on a probability obtained by the

30   probability calculation means, values of a mean parameter and a variance parameter of each normal distribution and a weighting parameter of each normal distribution, updating the stored parameter values while forgetting past data, according to newly read data to

35   rewrite the data of said parameter storage means, and wherein said method further comprises the steps of:

       determining to which cell of said histogram said discrete value data part belongs to send the continuous data part to the corresponding one of said probability

40   density estimation devices,

       calculating a score of said input data based on a probability distribution estimated from output values of said histogram calculation device and said probability

density estimation device and said input data, and

45   outputting the score calculation result as a

degree of outlier of said input data.